



CIRCUITRY VR



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Course Project for Dr. Demirel's CS 5970: Virtual Reality

01. Problem Statement

Students need a safe, hands-on environment to experiment with circuits.

Challenges with traditional tools:

- Hard to visualize
- Limited equipment access
- 2D simulators lack hands-on interaction
- Risk of damaging parts or feeling unsafe

02. Motivation

- VR makes circuits interactive and risk-free
- Lets learners physically manipulate components
- Escape-room design keeps learning engaging
- Makes circuits approachable, interactive, and fun

03. System Overview & Design

Architecture

- Wires connect to components to form a virtual circuit
- Scripts check polarity, loops, and validation
- Immersion: independent feedback from lights, audio, and fire hazards

Testing

- Used headset to verify collision accuracy, snap alignment, object placement, and loop detection

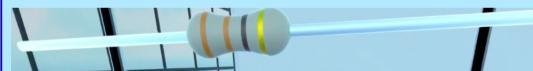


05. Components

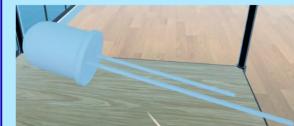
Switch



Resistor



LED



Battery



06. Features

Component Spawner

- Allows duplication of components
- Prevents spawners from colliding with active components

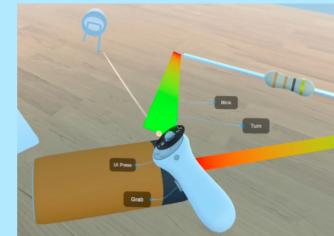


Game Manager

- Modified depth first search of wired components
- Determines if components are wired in a loop
- Decides if looped components meet level requirements
- Verifies that connected components follow polarity restrictions

Wiring System

- Connect components together at connection points
- Draws visible connections between parts
- Maintains internal wiring connections for polar components



Polarity Endpoints

- Added endpoint connection to all circuit components
- Ensured wiring only snaps to these polarity points (not object body)

Wiring Integration

- Updated wiring logic to detect and connect terminal nodes
- Adjusted colliders and interactables so wiring ignores component bodies and attaches cleanly at endpoints

04. Tools

- Unity (2022.3.56f1)
- Meta Quest 3
- XR Interaction Toolkit (3.1.2)
- OpenXR Plugin (1.14.1)
- External 3D Assets
- In-house scripting

Assets

- Course Library
- Unity Asset Store
- SketchFab
- and more

06. Features

Battery Fire

- Triggers when the pos. & neg. ends are wired
- Fire appears on the battery until user stops it



Fire Extinguisher

- Only when the trigger is pressed will the foam come out
- Foam particles collide with fire (tags & collision check)
- Fire disappears when foam particles touch it



07. Conclusion

Game Features

- Hazard modules
- Sandbox circuits
- Realistic 3D models



- Interactive components
- Physics-supported components and connections

Concept Summary

- Interaction with extinguisher
- Audio provides immersion
- Realistic component models
- Simple controls

